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Gas Journal

LIGHT - HEAT - POWER - BY-PRODUCTS

Vol. 242. 95th Year. LONDON, JULY 21, 1943. Registered as a Newspaper. No. 4183. Price 1/-

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GEORGE WILSON GAS METERS LTD.

MANAGING DIRECTORS OFFICE

July 21st, 1943.

TO THE GAS INDUSTRY.

Gentlemen,

I have in the past occasionally used the medium of advertisement space for making some statement of policy or opinion, although more often a circular letter was the natural agency. The latter being no longer permissible, I am taking this opportunity to say how much the consideration of the Gas Industry has been appreciated in the difficult times through which we have passed.

During the last few years many new ideas have been introduced and this Company has learnt much--with the co-operation and loyalty of its staff we look forward to the future with confidence and to be able to satisfy all the demands of the Industry.

Yours faithfully,

H. H. Wilson

Chairman & Managing Director.

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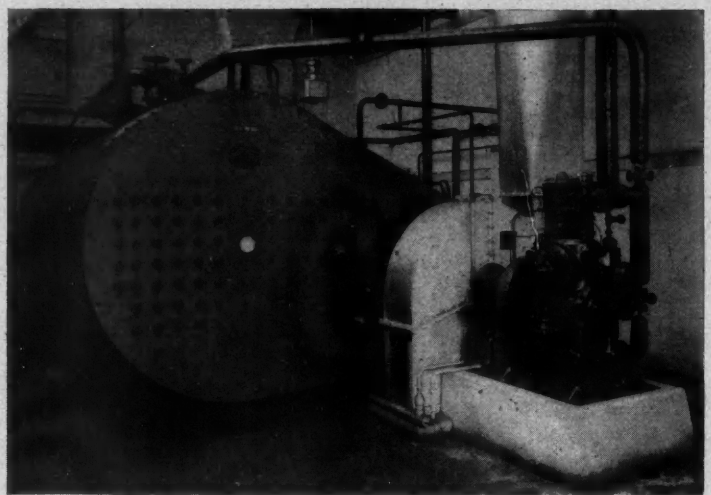

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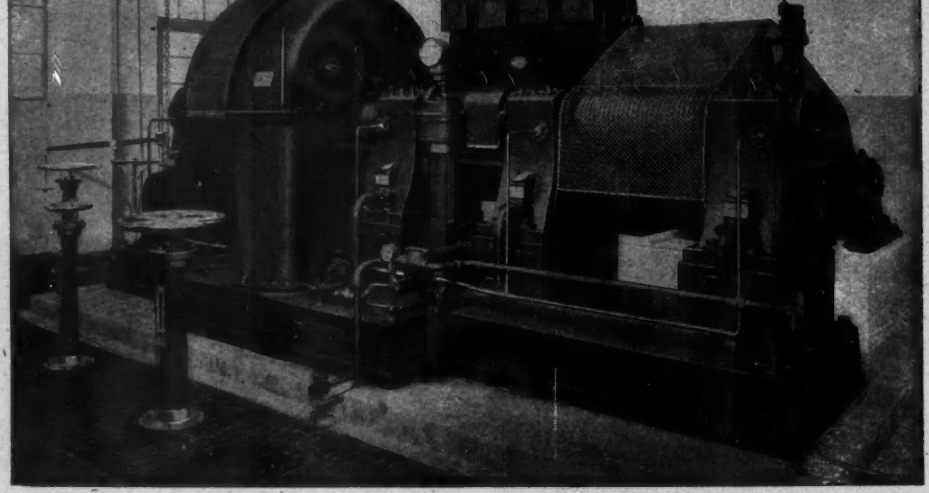

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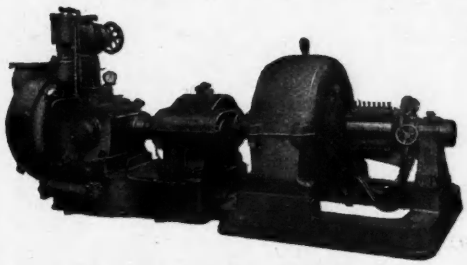

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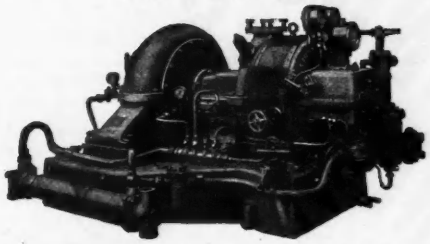

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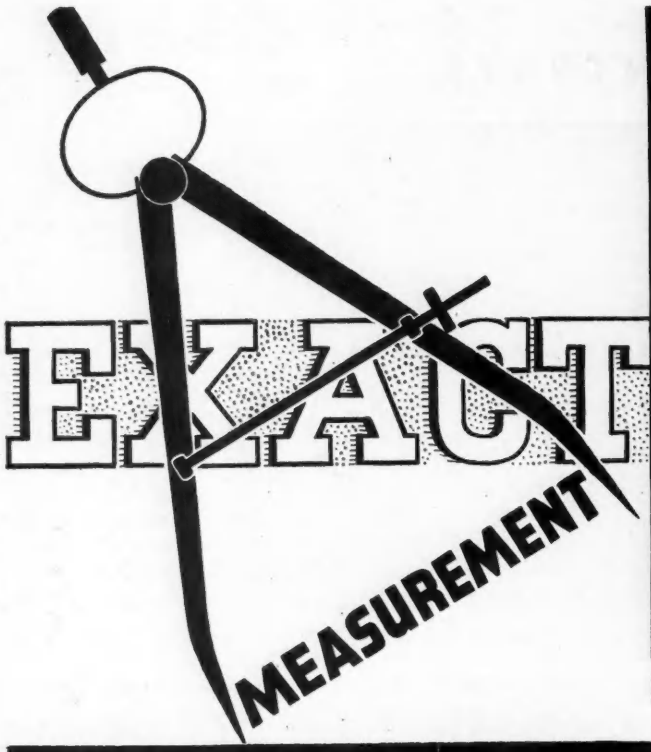

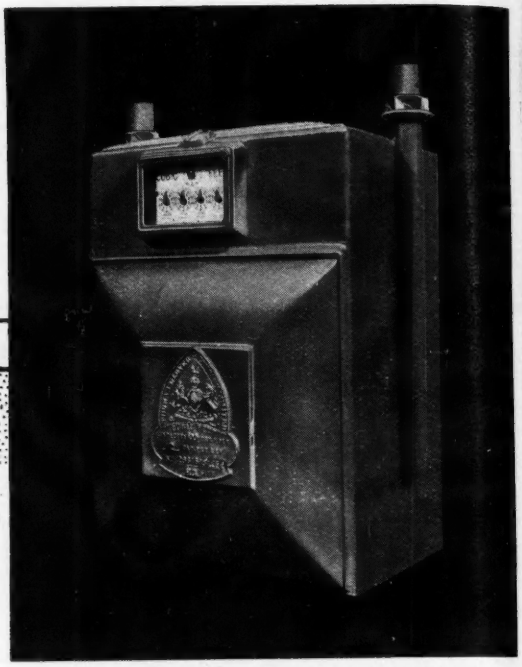

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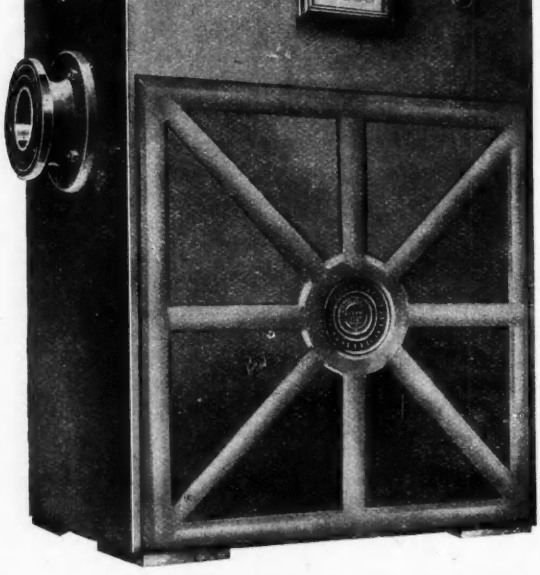

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P.8

GAS JOURNAL, JULY 21, 1943

VOL. 242 95th YEAR No. 4183

EDITORIAL NOTES

DESIGNER AND OPERATOR

IF we interpret him aright, the opinion of Mr. A. G. Grant expressed in his Institution Paper on the design and performance of gas-works plant is that chemical engineering, an analytical study of relatively recent growth, must play in the future a bigger part in gas manufacture. We think he is right. It is, in fact, for this reason that we have welcomed the establishment at Leeds University of a degree course in chemical engineering. We understand that as yet few students have come forward to undergo this somewhat lengthy and arduous training. However, the times are hardly propitious for a heavy entry of students in a comparatively new field—new as far as Leeds, at any rate, is concerned. Wartime conditions in no way damp our belief in the potential value of such a training. It seems to us that our Industry needs the engineer, the chemist, and the chemical engineer, and we are not at the moment prepared to assess their relative importance, though obviously co-operation between all three is necessary. We are sure, however, that in the past "gas engineer" has connoted the works man, the "gas manufacturer," to the detriment of the distribution side of the Industry's activities. We have seen the building of excellent gas-works to supply very poor distribution systems, legacies of the past, of course, but not justifying their existence on that score, and ruining in part efficient works procedure. We must somehow or other change this lack of balance post-war and we might to advantage consider now how we are going to redress the balance.

Mr. Grant did, *en passant*, touch upon the distribution aspect, but his main theme was manufacture of gas, with the emphasis on the scientific manner of approach. He said without ado that, with notable exceptions, the main contribution in the advance from empirical to scientific understanding of plant design in the Gas Industry has been made by the supplier of plant—the contractor. And he went so far as to add that this contribution has not always been appreciated by gas engineers. His argument was that the user of the plant must take a more critical interest in its performance, must try to understand the theory and basis of its design rather than be content to ensure that the plant is carrying out the duty required of it, or, in other words, fulfilling the makers' guarantees. In brief gas plant operators, from chief engineer downwards, ought to have a wider understanding of plant design—such understanding as "will encourage enterprise and development on the part of the contractors and will discourage the selection of plant the only virtue of which is its low first cost," the aim being the attainment and maintenance of the highest standards.

We hardly think that the Author meant his comments to be an indictment of the operators of plants supplied with an operational book of words, as it were, by the contractors and followed up by contractors' service. We suggest that Mr. Grant would readily admit that times without number since the last war progressive contractors, realizing the value of collaboration, have had cause to thank operators of their plant for modifications and improvement in design, advances brought about only by careful thought and critical analysis on the part of the gas engineer or the gas chemist or the chemical engineer (who may have developed into a chemical engineer by plant experience rather than by university lecture theatre). Numerous instances spring to our mind where the operator, far from being spoon-fed by the contractor, the designer of plant, has heartily disagreed with the contractor on some points—disagreed in the spirit of co-operation—to mutual advantage. And we are led away from pessimism regarding apathy in the future of the operators of plant by the infusion of trained critical—and youthful—minds in the Industry. Our work takes us about the country a good deal. We are sometimes discouraged by signs of apathy, but more often nowadays we are encouraged when we think of the likely influence of this infusion of trained young minds—an infusion which, of course, in quality and amount is in direct proportion to the remuneration offered. That is another subject and we do not intend to pursue it here, though it is thoroughly relevant to Mr. Grant's Paper. For in the expansion which it is hoped will follow the war there will be an increasing need for modified designs of plant and new distribution systems which will call for scientific training, scientific experience, scientific approach, and adequate remuneration.

SULPHUR REMOVAL

A LETTER which we are glad to publish in our correspondence columns to-day makes us think that the purport of our recent comments on the very important subject of sulphur removal from town gas has been misunderstood in some quarters. Perhaps we did not make our meaning clear. Our editorial in the "JOURNAL" of July 7 has been described as an unwarranted castigation of the Gas Industry, and the argument has in effect been advanced that whereas we had suggested that gas undertakings *in general* had exhibited a remarkably small measure of enthusiasm in tackling the problem of sulphur removal between the years 1933 and 1939, the truth is that gas undertakings were all agog about the matter, but that they were somehow or other frustrated in their keen desire to remove sulphur by lack of knowledge and lack of plant.

We will endeavour to make our meaning clearer. With all that has been said, written, explained, and advised on the question during the past ten years, we found it rather disheartening to hear the suggestion made in open meeting recently that sulphur removal is an unnecessary refinement not worth the expense involved—even to a limit of 10 grains or thereabouts per 100 cu.ft.—and that plant of the type for its removal to 3 or 4 grains is either a mystery or is in a not far advanced experimental stage. We ourselves had accepted that the experimental stage had in fact been well passed, and that there was no technical reason why any progressive gas undertaking with competent staff should not install the process, even if the plant did need understanding, and perhaps a measure of nursing. We fully realize, of course, the practical difficulties of installing new plant at the present stage; we appreciate that it hinges on the availability of steel, &c., for the purpose, and we are aware of what would appear at the present moment to be the thin prospect of obtaining the needful allocation. We know, too, that several gas undertakings would now be removing sulphur by the catalytic process if it were possible to install the plant, which, according to our knowledge, is a technical and commercial proposition, and not in any way a scientific mystery. To blame such undertakings which, through *force majeure*, cannot act in the matter would indeed be foolish and an unwarranted criticism.

What has rather disturbed us is an attitude of mind which seems to have prevailed on the subject generally between the years 1933 and 1939, during which period more, we think, could have been "done about it." After all, in 1937, gas engineers were given full information of the oil-washing process as practised and developed by the Gas Light & Coke Company from 1927, but we do not think that all gas engineers were wildly enthusiastic as to the possibilities in usage of a gas containing 10 grains of sulphur per 100 cu.ft.—let alone a gas having only 4 grains. And we do feel that the Industry as a whole could well have tackled the problem with more serious intent. In saying this we do not forget those undertakings which did in fact translate good intention into practice, greatly to their own advantage and to that of their consumers, domestic and industrial, and helpful to the Gas Industry's prestige.

A Tribute to the Director

Although not professionally associated with coal treatment, Mr. W. H. J. Stevens, for nearly 40 years an Associate of the Junior Institution of Engineers, made the study of oil from coal his hobby, and when he died a year ago at the age of 87 he bequeathed a sum of money to the Institution to provide for the reading of a series of Papers concerned with the better utilization of coal for the production of oil, petrol, and other by-products. The Institution, of which Sir David Milne-Watson is now President, has asked Dr. J. G. King, Director of the Gas Research Board, to undertake all the arrangements for the Stevens Memorial Lectures, of which it is intended that one shall be delivered annually for the next five years, and Dr. King has himself promised to give the introductory Lecture on May 5, 1944, under the full title of "The Production of Oil from Coal—Lecture 1: The Development of the Tar Industry." The Junior Institution of Engineers—"junior" in title only, for it celebrates its diamond jubilee this year—numbers among its members a considerable number of gas engineers, and the new series of Lectures will therefore constitute a welcome addition to its transactions. At the same time it is a source of gratification to the Gas Industry that so soon after his appointment as Director, Dr. King should have been invited to arrange for a complete review of the important work which has been achieved in this direction.

Personal

Mr. H. HILL, for some years assistant to the Alliance and Dublin Consumers' Gas Company, and son of Mr. Rowland Hill, for many years connected with the Bradford Road Works of the Manchester Gas Department, has been appointed Assistant Engineer and Manager to the Llanelly Gaslignt Company.

Obituary

The death occurred at Belfast on July 17 of Alderman Albert HODGEN, J.P., for several years Chairman of the Belfast Gas Committee. He had been a member of the Belfast City Council for 26 years.

Letter to the Editor

Sulphur Removal

DEAR SIR,—Some discussion has taken place recently on the slow progress being made by gas undertakings in carrying out the recommendations of the Institution Report of the Committee of Enquiry on Sulphur Removal. Your Editorial in the "GAS JOURNAL" of July 7 again refers to the matter, and you express bewilderment and astonishment at the hesitancy regarding sulphur removal shown by so many gas undertakings. Judging from my own experience I agree with Mr. C. R. Ingham that your Editorial comments on the subject are an unwarranted castigation of the Industry.

We have for some years been distributing gas at Middlesbrough with a sulphur content of 10 grains. The Institution Report was only published in October last, and I immediately decided to prepare for the installation of a plant to bring the sulphur content down to the recommended 3 grains as soon as information was forthcoming that there was such a plant on the market; and in view of the Institution Report it was to be expected that considerable publicity would be given when the plant was available.

In February last I happened to notice a brief reference tucked away in an advertisement in your columns of one of the gas plant manufacturers referring to catalytic sulphur removal plants. I wrote this firm intimating that I was anxious to proceed with the installation of such a plant, and wished to go into full details. Their reply stated that some small units had been installed from which it appeared feasible to bring the sulphur content down to 4 grains, and that the experience gained on these small working units would be extremely valuable for dealing with the complete production of gas undertakings, when the convenient time arose. This is as far as I have been able to get, and it is not very helpful. In any case, even if a suitable plant did exist, it is extremely doubtful whether authority would be given to obtain materials for the erection of such a plant at the present time.

Gas-Works, Middlesbrough. Yours faithfully,
July 13, 1943. JOHN W. PALLISTER,
Engineer and Manager.

Diary

July 27.—Gas Research Board: Patents Sub-Committee, Gas Industry House, 12.30 p.m.

July 27.—Gas Research Board: Council Meeting, Gas Industry House, 2.30 p.m.

July 29.—Association of Gas Corporations: 2 p.m., Finance Sub-Committee; 2.30 p.m., General Purposes Committee; 3.30 p.m., Council; 2, Chart Lane, Reigate.

July 29.—Midland Junior Gas Association: Meeting in Birmingham, 4.15 p.m. Paper by S. C. Bentley on "Design and Operation of a Gas Liquor Concentration Plant."

British Gas Federation

The review and proposals of the Post-War Planning Committee have been embodied in a draft report, the object of which is to improve the service the Industry can render to the community, and to ensure its development and expansion in the national interest. The numerous and complex questions involved in the report have been remitted to the Districts for their views.

One of the major questions, however, arising out of these proposals is that regarding the future ownership and control of gas undertakings. With the object of considering this issue, representatives of proprietors of gas undertakings were invited to a meeting which was held on July 15 at the Central Hall, Westminster, and a large number of Chairmen of gas undertakings (municipal and company owned) or their deputies, together with their chief officials, attended. After full discussion it was ultimately agreed that further time was required by undertakings for consideration of the subject, and that thereafter another meeting should be called.

National Gas Council

A Meeting of the Central Executive Board of the National Gas Council was held on July 13 at Gas Industry House. Mr. Frank H. Jones, M.Inst.C.E., M.I.Mech.E., J.P. (Vice-Chairman), presided. A letter was read from Sir David Milne-Watson, expressing his appreciation of the honour done him in electing him an Honorary Member of the Council.

A report on the general coal position was received. The recommendations of the Coal Committee of the Conjoint Conference of Public Utility Associations made at a meeting on June 22 and adopted by the Council of the Conference at a subsequent meeting had been circulated in a written report.

Mr. E. V. Evans, Chairman of the Gas Advisory Committee to the Ministry of Fuel and Power, made a report to the Board.

It was agreed that a Committee consisting of purchasers of coke oven gas should be set up to whom matters affecting their special interests could be referred.

The next meeting of the Board will take place on Aug. 10.

A Dividend of 6% was declared at the annual meeting of the Duns Gaslight Company last week. At a subsequent meeting it was decided to form the concern into a limited liability company.

"Certificates of Honour" have been awarded to both the Stratford Place and Luton Savings Groups of the Davis Gas Stove Company Ltd. (Radiation Ltd.), in recognition by the Government of "Special Achievement" during the Wings for Victory Campaign.

We have been advised by the Concrete Proofing Company, Ltd., that their address is now 100, Victoria Street, London, S.W.1. Telephone: Victoria 7877 and 6275. Telegraphic address: Prufcrete, Phone, London.

Another Useful Feather in "Wings for Victory" was contributed by the workpeople of John Wright & Co., Ltd. (Radiation Ltd.), in their recent Savings Group effort, the target for which was £5,000 to purchase a Spitfire. A total of £7,300 was reached, enabling not only the Spitfire but all its equipment to be purchased together. This was entirely the result of the employees' efforts, and apart from the Company's contributions. The firm's broadcasting equipment was put at the disposal of one of the workpeople each day to urge the others on to greater efforts, and a disabled R.A.F. Flying Officer came specially to give an encouraging lunch-time talk.

In the House of Commons Sir Arnold Gridley asked the Minister of Fuel and Power what steps he had taken to bring to the notice of industrial users the possibilities of economizing fuel by means of the application of thermostatic control, and if he was satisfied that sufficient thermostatic control units were being manufactured. Major Lloyd George replied that his Ministry last February issued a bulletin setting forth the merits of thermostatic control in appropriate circumstances, and its value was being stressed in publicity addressed to industrial consumers. Although he would not like to say he was satisfied that the production of thermostats was adequate, he had made arrangements for a substantial increase in output.

The Minister of War Transport proposes to amend Regulation 82 (3) of the Motor Vehicles (Construction and Use) Regulations, 1941, which provides that a motor vehicle may not be left unattended unless the engine is stopped, as as to permit a motor vehicle propelled by producer gas to be left unattended without the engine having been stopped. The Minister wishes to impress on operators the necessity of ensuring that the hand brakes of these vehicles are maintained in a fully effective state. Users wishing to take advantage of the concession must make provision (*e.g.*, by the use of a locking device on the steering-wheel or on a road wheel) to enable them to comply with the Ministry of Home Security Order as to immobilization in those areas where it still applies.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in the "Journal" should not be taken as an indication that they are necessarily available for export.

THE DESIGN OF DISTRIBUTION SYSTEMS TO SUPPLY POST-WAR DEVELOPMENT

Institution of Gas Engineers, July 9.

By H. J. ESCREET, B.Sc.(Eng.), M.Inst.C.E.,
Distributing Engineer, Gas Light and Coke Company

Although there was much new building after the 1914-18 war, and indeed during the 20 years from 1919 to 1939, this was generally carried out by private enterprise in relatively small estates of a few hundred houses each. A distributing engineer, endeavouring to plan mains to meet the future development of his district, would know that new estates were being built in various parts of his area, but had no reliable information as to where or to what extent further development would occur. It was impossible to calculate what quantities of gas would be required in the various parts of his district within, say, 10 or 20 years, and from that to decide upon the correct size of trunk main; he was therefore forced to meet the development by extensions from existing mains and, at a later stage, provide additional feeder mains and governors to supply those parts of the district which had outgrown the capacity of the existing trunk mains.

After this war there will be new building on a larger scale than in the period from 1919 to 1939, because the damage resulting from air raids must be made good, slum clearance schemes already in hand in 1939 must be completed and many new re-housing schemes carried out. The creation of a Ministry of Town and Country Planning, and the work of the numerous committees considering post-war housing problems, give rise to hopes that comprehensive schemes for post-war building may be produced and decisions as to the form of future development, e.g., by the building of satellite towns, extension of selected small towns, or other means, may be made at an early date. Should these hopes materialize, the distributing engineer may have the opportunity of designing a distribution system to meet the probable development in his Undertaking's area for, say, 20 years ahead, and the object of this Paper is to examine the costs of alternative methods of distribution with a view to providing data for discussion as to the form which the distribution system of the near future should take.

The Distribution System

Should future housing development take the form of new satellite towns, or should a "gas grid" be provided to link up existing Undertakings, it may well be that bulk supplies over distances up to, say, 50 miles would be provided to supply the new towns, rather than that new gas manufacturing stations should be provided in or adjacent to them; in such cases it would probably be desirable to provide a holder station in or near the town from which the feeder mains and local distribution system would be supplied.

It is proposed, therefore, to treat the distribution system in four sections:

(1) Transmission main (for supply in bulk).
(2) Local storage.
(3) Local trunk mains.
(4) Local distribution (including services).

In designing a distribution system the length of mains (a) is determined by the distance of transmission or the lay-out of the town or estate; the volume of gas (b) to be supplied is determined by the number of consumers and the demand per consumer; the size of main (c) and the pressure required (d) are dependent on (a) and (b) but are also inter-dependent, i.e., the use of higher pressures enables smaller mains to be used for the same distance and volume of gas, and *vice versa*, and it is in a decision as to the use of "low" or "high" pressures that the distributing engineer has his principal choice in determining the type of distribution system to use. Thus

(1) Transmission may be against a low or high terminal pressure.
(2) Local storage may be at low or high pressure.
(3) Local trunk mains may operate at low or high pressure.
(4) Local distribution may be at low pressure or at high pressure (with service governors).

While "low" pressure is generally understood as referring to pressures up to, say, 12 in. w.g., "high" pressure may include any pressures from 1 lb. per sq. in. upwards. It is proposed in this Paper to use the term "intermediate" pressure for pressures from 1 lb. to 10 lb. per sq. in., and "high" pressure for pressures above that range.

Except in rural districts the choice of pressures for local trunk mains and local distribution will generally be between low and intermediate, and in the following sections of the Paper the influence on costs of high or low pressure on items (1) and (2) and of intermediate or low pressure on items (3) and (4), and various combinations of these, will be examined.

Typical Distribution Systems for a Town of 100,000 Inhabitants

The detailed comparison of costs* may best be made by reference to a typical case, and a large estate of 25,000 houses, which was developed to the east of London between 1920 and 1934, has been taken for this purpose. The estate covers an area of 5 sq. miles, measuring about 2 miles from east to west and 2½ miles from north to south, and forms a complete town with shopping centres, schools, etc.

The annual consumption of this town pre-war was about 2·75 mill. therms (550 mill. cu. ft. of 500 B.Th.U. gas), an average of 110 therms (22,000 cu. ft.) per consumer.

Taking the maximum day's consumption as $\frac{1}{330}$th of the annual consumption and the maximum hour's consumption as $\frac{1}{10}$th of the maximum day, the following figures of consumption have been calculated:

	Therms	Cu. ft.
Average day	7,500	1,500,000
Maximum day	13,750	2,750,000
Average hour	315	63,000
Maximum hour	1,375	275,000
Average hour of maximum day	575	115,000

Existing Distribution System

The town is supplied at low pressure by some 95 miles of mains of from 4 in. to 12 in. diameter, these being fed by six underground governors, one near the centre of the town and five round the periphery. These governors are supplied through feeder mains of from 24 in. to 12 in. diameter, working at pressures up to 5 lb. per sq. in. There is no local storage, but consideration will be given to the supply of a similar town with local storage equivalent to the average day's supply, either in one unit or in six small units (one at each governor station).

Proposed Distribution System

If a similar town were to be built in the future, the distribution system might be planned as follows:

High-pressure storage stations, of a total capacity of 1·5 mill. cu. ft., storing gas at a pressure of 50 lb. per sq. in., are provided at five positions round the town, and are fed with gas from a 6-in. ring main. Each storage station feeds two or three 4-in. mains through a governor set to maintain a pressure of 10 lb. per sq. in. These 4-in. mains form the principal supply mains to the town, and 2-in. branches from them supply the remaining streets. Service governors are provided for every supply. A pressure loss of 5 lb. per sq. in. is allowed on the 4-in. mains and 4 lb. per sq. in. on the 2-in. mains, leaving a minimum pressure of 1 lb. per sq. in. available at the service pipe.

The storage stations might be omitted and the governors supplied from local trunk mains operating at a minimum pressure of 10½ lb. per sq. in.

The costs per therm for local storage, local trunk mains and local distribution would be practically the same for a smaller town, say, of 5,000 houses, and in the following section the costs of transmission are calculated both for the above town and for one of one-fifth of that size, so that total costs for both the large and small town may be compared.

* Throughout this Paper the costs are based on the prices of materials and rates for labour in 1938.

Cost of Transmission of Bulk Supply

In this section the costs of transmission of the whole of the gas required for the town described in the previous section, over distances of 10, 25 and 50 miles, are calculated for the following four conditions :

(a) Direct Supply to Low-Pressure Distribution System

The main must be capable of delivery at the rate of the maximum hour's demand, namely, 275,000 cu. ft. per hr.* Allowing for a minimum pressure of 0·5 lb. per sq. in. in the local trunk mains, the terminal pressure of the main must be 1 lb. per sq. in.

(b) Direct Supply to Intermediate Pressure Distribution System

The main must have the same capacity as for (*a*), but the terminal pressure will be 12 lb. per sq. in. (minimum of 10·5 lb. per sq. in. on inlet of governor and 1·5 lb. per sq. in. loss in local trunk mains).

(c) Supply through High-Pressure Storage to Intermediate Pressure Distribution System

The main capacity need only be sufficient for the average hour of the maximum day, namely, 115,000 cu. ft. per hr. The terminal pressure will be 60 lb. per sq. in., allowing for storage at 50 lb. per sq. in. and 10 lb. per sq. in. margin for loss in the ring main, connexions to holders, etc.

(d) Supply through Low-Pressure Storage to Low-Pressure Distribution System

The capacity of the main will be as for (*c*), but the terminal pressure need only be 1 lb. per sq. in., allowing for the losses in the local trunk mains and the pressure thrown by the holders.

The most economical size of main and pumping pressure for each of the foregoing cases is shown in the top part of Table 1, together with the costs per therm. The lower half of Table 1 gives similar information for the transmission of one-fifth of the quantities referred to above. These figures would apply to the supply of a town of about 5,000 houses.

Terminal Pressures

The effect of the higher terminal pressures upon the pressure loss in the main is of interest. Comparing cases (*a*) and (*b*) at 10 miles, it will be noted that the pressure loss on an 18-in. main for a terminal pressure of 12 lb. per sq. in. is only 2·5 lb. per sq. in., compared with 3·9 lb. per sq. in. when the terminal pressure is 1 lb. per sq. in. Similarly, for cases (*c*) and (*d*) at 10 miles, with a 10-in. main and a terminal pressure of 60 lb. per sq. in., the loss is only 3 lb. per sq. in., compared with 5·4 lb. per sq. in. on a 12-in. main for a terminal pressure of 1 lb. per sq. in. For a distance of 50 miles, case (*a*) shows a pressure loss of 56 lb. per sq. in. as against 49 lb. per sq. in. for case (*b*), the size of main being 12 in. in both cases, and case (*c*) shows a loss of 38 lb. per sq. in. on an 8-in. main, compared with 36 lb. per sq. in. on a 10-in. main for case (*d*). Similar comparisons may be made of cases (*e*) and (*f*) and cases (*g*) and (*h*). A further note on this subject is given in Appendix 1.

Pumping Costs

The capital cost of pumping plant varies, of course, according to the type of compressor and prime mover, and the costs of building and connexions also vary according to the local circumstances of each case. The costs used in the calculations can, therefore, only be considered as approximate average costs, but it is believed that they are reasonably correct for normal conditions and are at least comparable as between one size of plant and another. The running costs of pumping are based on ½d. per horse-power hour, and here again the actual cost would depend on the type of prime mover and local circumstances with regard to cost of fuel, attendance, etc.

In the case of direct supply it has been assumed that the plant would run continuously, 8,760 hr. per annum, but as it would only be working at low load for much of this time the costs have been calculated on full load running for 7,000 hr. per annum. For supply through holders a yearly total of 5,000 hr. at full load has been assumed. The minimum pumping time would be

$$\frac{\text{annual consumption}}{\text{rate of pumping}} = \frac{550{,}000{,}000}{115{,}000} = 4{,}783 \text{ hr.}$$

The margin allows, however, for the inevitable additional running due to failure to regulate the pumping exactly in accordance with requirements.

In both cases, of course, costs can only be kept down to the calculated figures by careful control, and it must be admitted that there is a general tendency for pumping plant to run unnecessarily in order to " make sure there is plenty of pressure " ; but with equal degrees of care the ratio of the actual costs for pumping direct and through holders should be reasonably close to the ratio of these costs as calculated above.

* The absolute peak load, over a period of 5 or 10 min., may be about 20 per cent above the rate of the maximum hour, but as the maximum hour's demand quoted is only an approximate figure, this short time peak has been ignored in the calculations.

TABLE 1.—*Comparative Costs of Transmission*

Case	Distance from Source of Supply.....			10 miles					25 miles					50 miles				
	Type of System	Terminal Pressure, lb. per sq. in.	Volume per hr., cu. ft.	Initial Pressure lb. per sq. in.	Size of Main, in.	Annual Charge, pence per therm			Initial Pressure, lb. per sq. in.	Size of Main, in.	Annual Charge, pence per therm			Initial Pressure, lb. per sq. in.	Size of Main, in.	Annual Charge, pence per therm		
						Main	Pumping	Total			Main	Pumping	Total			Main	Pumping	Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
(*a*)	Direct supply to low-pressure distribution system	1	275,000	4·9	18	0·43	0·27	0·70	9·7	18	1·08	0·46	1·54	57	12	1·08	1·34	2·42
(*b*)	Direct supply to intermediate pressure distribution system	12	275,000	14·5	18	0·43	0·60	1·03	29·0	14	0·77	0·94	1·71	61	12	1·08	1·39	2·47
(*c*)	Supply through high-pressure storage to intermediate-pressure distribution system	60	115,000	63	10	0·17	0·49	0·66	81	8	0·35	0·54	0·89	98	8	0·69	0·58	1·27
(*d*)	Supply through low-pressure storage to low-pressure distribution system	1	115,000	6·4	12	0·22	0·12	0·34	12·6	12	0·54	0·18	0·72	37	10	0·85	0·37	1·22
(*e*)	Direct supply to low-pressure distribution system	1	55,000	4·4	10	0·84	0·28	1·12	8·7	10	2·13	0·46	2·59	30	8	3·45	1·09	4·54
(*f*)	Direct supply to intermediate - pressure distribution system	12	55,000	18·0	8	0·69	0·80	1·49	25·3	8	1·72	0·97	2·69	35	8	3·45	1·17	4·62
(*g*)	Supply through high-pressure storage to intermediate-pressure distribution system	60	23,000	73	4	0·46	0·58	1·04	89	4	1·15	0·62	1·77	111	4	2·30	0·72	3·02
(*h*)	Supply through low-pressure storage to low-pressure distribution system	1	23,000	3·2	8	0·69	0·08	0·77	59	4	1·15	0·52	1·67	88	4	2·30	0·62	2·92

An examination of the costs per therm in cols. 8, 13 and 18 of Table 1 shows that while, of course, the cost increases with length of main the difference between costs for direct supply at terminal pressures of 1 lb. per sq. in. and 12 lb. per sq. in. becomes less as the distance increases, and at 50 miles the difference is only 0·05 pence per therm for 275,000 cu. ft. per hr. and 0·08 pence per therm for 55,000 cu. ft. per hr. The same applies in the case of transmission to high-pressure and low-pressure holders, and again at 50 miles the difference in cost is only 0·05 pence per therm for 115,000 cu. ft. per hr., and 0·10 pence per therm for 23,000 cu. ft. per hr.

The difference between cost of direct supply and supply through holders increases with distance. At 10 miles there is little difference between the cost of direct supply to a low-pressure system and supply through high-pressure storage, but at 50 miles the cost for case (*c*) is only half that for case (*a*), and the cost for case (*g*) only two-thirds of that for case (*e*).

At all distances direct supply to an intermediate-pressure system is the most expensive and supply to low-pressure holders is the least expensive.

Effects of Increases in Load

The transmission costs quoted above refer to the present load in the town, and it is interesting to examine the effects of a large increase in the volume to be transmitted.

As an illustration, Table 2 has been compiled. This shows the initial pressures required and cost per therm pumped due to an increase of 100 per cent in the volume of gas transmitted—assuming the use of the mains already laid to supply the present demand. It has also been assumed that the load factor remains unchanged. Actually if the size of the town remains the same the increase in output could only take place by (i) increased use of gas for space heating and water heating, (ii) additional industrial supplies. In both cases the daily load factor would be improved, although (i) would probably make the seasonal load factor worse.

It will be seen from Table 2 that doubling the load has very little effect on the cost per therm of pumping when the gas is supplied to high-pressure storage. For supply through low-pressure storage the increase is only about $\frac{3}{10}$d. per therm, while for direct supply, either to low-pressure or intermediate pressure systems, the increase in cost is under ¼d. for a distance of 10 miles and under ½d. for 50 miles.

The reason for the very small increase in the cost when transmitting to high-pressure holders is the high-pressure range which, as explained in Appendix 1, results from the terminal pressure of 60 lb. per sq. in. It will be noted that at 10 miles the initial pressure is only increased by 8 lb. per sq. in. when the volume is doubled, while at 50 miles the increase is from 98 lb. per sq. in. to 162 lb. per sq. in—only about 65 per cent. In addition, the horse-power required per 1,000 cu ft. only increases from 4·3 to 5·3 for this 65 lb. per sq. in. increase in initial pressure.

Owing to the reduced charge per therm for the main the total cost of transmission is reduced in all cases, except direct supply to a low-pressure system at 10 miles; the maximum reduction amounts to about ¼d. per therm for supply through high- or low-pressure storage at a distance of 50 miles.

Local Storage Stations and Local Trunk Mains

It is advantageous to provide for local storage of a capacity equal to the average day's consumption, i.e., 1·5 mill. cu. ft., for the following reasons:

(1) Storage at the point of usage enables the load on the trunk main supplying the town to be kept constant throughout the 24 hr. The maximum rate of pumping need not exceed that required for the average hour of the maximum day—in the case under consideration 115,000 cu. ft. per hr. instead of the peak-hour load of 275,000 cu. ft. per hr. During the summer and other periods of light load, the pumping plant may be operated at full load when in use and shut down when the storage is full.

(2) The storage provides for continuous supply to the town should the trunk main or pumping plant have to be shut down for repairs or overhaul, up to a limit of 12 hr. in winter, or, say, 36 hr. in summer. A duplicate trunk main is therefore unnecessary and spare pumping plant may be reduced to a minimum.

(3) Should a grid system of gas supply be developed, it would be necessary to provide considerable storage, and it is very much better that this should be spread over the country rather than concentrated at the large manufacturing stations.

High- and Low-Pressure Storage

The capital costs of high- and low-pressure gasholders for various capacities are shown in Table 3, which also gives the annual charges.

TABLE 3.—*Capital Costs and Annual Charges for Gasholders of Various Capacities*

Capacity, thous. cu. ft.	Capital Costs, £		Annual Charges, £	
	Low-Pressure	High-Pressure	Low-Pressure	High-Pressure
1	2	3	4	5
1,500	40,000	90,000	3,000	5,850
500	21,500	30,000	1,615	1,950
250	12,000	15,000	900	975
150	6,500	9,000	487	585

The capital costs for high-pressure storage are based on the use of units of a capacity of 150,000 cu. ft. between full storage pressure of 50 lb. per sq. in. and a minimum pressure of 10 lb. per sq. in. A cylindrical unit of this capacity would be approximately 25 ft. in diameter by 125 ft. in length, and the cost would be about £9,000, including erection and foundations, etc. The capital costs for low-pressure holders are in each case for one holder of the capacity shown.

The annual charges are calculated at 7·5 per cent for low-pressure holders and 6·5 per cent for high-pressure holders, of which 5·5 per cent in both cases is for interest and depreciation (corresponding to a life of 50 years). The balance covers painting and other maintenance costs, and the lower charge in the case of high-pressure holders is thought to be justified by the following considerations:

(*a*) The life of the paint on a high-pressure holder should be longer than on a low-pressure holder, because it is not subject to frequent immersion in tank water.

TABLE 2.—*Effect on Cost of Transmission of Increase of* 100 *per cent in Load*

Method of Supply	Distance, miles	2,750,000 therms per annum				5,500,000 therms per annum				Decrease in Cost, pence per therm
		Initial Pressure, lb. per sq. in.	Transmission cost, pence per therm			Initial Pressure, lb. per sq. in.	Transmission cost, pence per therm			
			Main	Pumping	Total		Main	Pumping	Total	
1	2	3	4	5	6	7	8	9	10	11
Direct supply to low-pressure distribution system	10	4·9	0·43	0·27	0·70	12·5	0·22	0·53	0·75	0·05 (increase)
	25	9·7	1·08	0·46	1·54	24	0·54	0·79	1·33	0·21
	50	57·0	1·08	1·34	2·42	118	0·54	1·78	2·32	0·10
Direct supply to intermediate-pressure distribution system	10	14·5	0·43	0·60	1·03	20	0·22	0·72	0·94	0·07
	25	29	0·77	0·94	1·71	55	0·39	1·27	1·66	0·05
	50	61	1·08	1·39	2·47	120	0·54	1·78	2·32	0·15
Supply through high-pressure storage to intermediate-pressure system	10	63	0·17	0·49	0·66	71	0·09	0·48	0·57	0·09
	25	81	0·35	0·54	0·89	121	0·18	0·58	0·76	0·13
	50	98	0·69	0·58	1·27	162	0·35	0·65	1·00	0·27
Supply through low-pressure storage to low-pressure system	10	6·4	0·22	0·12	0·34	16	0·11	0·21	0·32	0·02
	25	12·6	0·54	0·18	0·72	30	0·27	0·31	0·58	0·14
	50	37	0·85	0·37	1·22	80	0·43	0·50	0·93	0·29

(*b*) There are no moving parts in the high-pressure holder and therefore no lubrication is required, and repairs should be negligible.

(*c*) There is no danger of freezing in high-pressure holders and therefore no provision of anti-freezing equipment, boilers, etc. is necessary nor any stoking of boilers. This is particularly advantageous in the case of outlying holder stations.

The proposed lay-out of the mains for the town is based on the provision of high-pressure storage built at five holder stations on the outskirts, each holder station containing two 150,000-cu. ft. holders, a total of 10 units. Consideration is also given, however, to the provision of low-pressure storage (*a*) in one large holder of a capacity of 1,500,000 cu. ft., and (*b*) in six holders, each of a capacity of 250,000 cu. ft., situated at the sites of the governors on the low-pressure system.

The capital costs and annual charges* for the three cases would be:

Case	Capital Cost, £	Annual Charge, £	Annual Charge, pence per therm
1	2	3	4
Five high-pressure storage stations, each with two 150,000-cu. ft. holders	90,000	5,850	0·51
One 1,500,000-cu. ft. low-pressure holder	40,000	3,000	0·26
Six 250,000-cu. ft. low-pressure holders	72,000	5,400	0·47

Although the high-pressure storage is more expensive than the low-pressure storage, it is considered that the extra cost is compensated for by the advantages of storage at pressure, enabling intermediate pressures to be obtained direct from the holder, by the use of small units which could easily be added to if required, by the absence of moving parts, freezing, etc., which renders occasional inspection the only attendance required, and by the ease with which these holders can be concealed by planting trees round the storage site. The last feature should greatly facilitate the obtaining of suitable sites, particularly if arrangements were made in the early stages of development before houses were erected—probably the only consent necessary when applying for the site to be scheduled would be that of the authority planning the estate.

Another advantage of high-pressure storage is the ease with which the stock of gas may be recorded and transmitted to some central control point by means of pressure-measuring instruments. The volume of gas in a high-pressure holder depends upon the pressure at which it is stored and any type of distant recording pressure gauge will therefore serve as a volume-recording instrument. By providing each holder with a pressure recorder connected to the pumping station, it would be possible to have at all times a record of the stock of gas at each holder. An additional recorder on the inlet main to the holders would allow the pumping pressure to be adjusted to suit the requirements and enable unnecessary running of the pumps or excessive pressure to be avoided.

Local Trunk Mains

The term " local trunk mains " is used to describe those mains which connect the end of the transmission main to the local storage stations or distributing centres (governors). As the size and arrangement of these mains depends upon whether or not local storage is provided, and upon the type of local distribution system, it is convenient to deal with them in this section.

Low-Pressure System

(*a*) As has been stated in a previous section, the town is actually supplied through trunk mains of diameters from 24 in. to 12 in., operated at pressures up to 5 lb. per sq. in. These mains, however, also supply parts of the surrounding district, and, for the supply of the estate only, the following local trunk mains* would be adequate:

5,900 yd. of 18 in. main at £3 10s. per yd. ..	£20,650
7,050 yd. of 14-in. main at £2 10s. per yd. ..	17,625
Total ..	£38,275

(*b*) If one 1,500,000-cu. ft. holder were provided at the end of the transmission main, the local trunk mains would require to be of ample size to avoid large pressure losses, and it is considered that these should be of the same size as in (*a*).

(*c*) If six low-pressure storage stations, each of 250,000-cu. ft. capacity, were provided at the distributing centres, the local trunk mains supplying these would only have to deal with the average hourly demand, and the size could be reduced to 12 in. The length required would be as in (*a*) above, namely, 12,950 yd. and the cost, at £1 16s. per yd., would be £23,310.

Intermediate-Pressure System

(*d*) The high terminal pressure required for supply to high-pressure storage makes it economical to use a small diameter main for the inlet to these storage stations, the pressure losses in this main being relatively unimportant compared with the high initial pressure on the transmission main. The capacity of the main must not, however, be so small as to limit unduly the rate of filling of the storage farthest from the point of supply. The capacity should be such that when the holder nearest to the transmission main and the one farthest from it were both equally low in stock, the latter would start filling as soon as the former was, say, 5 lb. per sq. in. higher in pressure, i.e., the main should have sufficient capacity to fill the farther holders relatively quickly with a difference of pressure of only 5 lb. per sq. in. between the nearest and farthest points of the main. Otherwise the nearest holder would tend to keep full, whilst the farthest continued to lose stock. In the present case a 6-in. ring main would be suitable. Each holder station would be connected to the ring main through a non-return valve so that the holder with the lowest stock and therefore the lowest pressure would commence filling first. The length of main required would be 12,500 yd., and the cost, at £1 per yd., would be £12,500.

(*e*) For direct supply, i.e., without storage, a similar ring main would be required, but as the peak load would have to be supplied through the main and the pressure drop available is only 1½ lb. per sq. in., a 14-in. main would be required. The length would be 12,500 yd., and the cost, at £2 10s. per yd., would be £31,250.

TABLE 4.—*Summary of Costs*

System	Capital Cost, £			Annual Charge, pence per therm†		
	Local Trunk Mains	Holder	Total	Local Trunk Mains	Holder	Total
1	2	3	4	5	6	7
Low-pressure, direct supply	38,275	—	38,275	0·27	—	0·27
Low-pressure with 1,500,000-cu. ft. holder	38,275	40,000	78,275	0·27	0·26	0·53
Low-pressure with six 250,000-cu. ft. holders	23,310	72,000	95,310	0·16	0·47	0·63
Intermediate-pressure through five high-pressure storage stations, each of 300,000-cu. ft. capacity	12,500	90,000	102,500	0·09	0·51	0·60
Intermediate-pressure direct supply ...	31,250	—	31,250	0·22	—	0·22

Although the total charge for low-pressure storage in six units is 0·1d. per therm greater than for storage in one large unit, the six holders would have the great advantage that any one unit could be put out of action for painting or other maintenance without serious interference with the supply. In the case of the single large holder, any such work could only be carried out

* In the costs given in later sections of the Paper it has been assumed that the charge for storage is allocated to the cost of supplying the town, but actually the local storage can partly replace storage at the manufacturing stations and might therefore be allocated, at least in part, to cost of manufacture. This question is, however, outside the scope of this Paper.

* The economical size of the local trunk mains will vary with the distance of transmission, i.e., as the distance of transmission increases and the pressure loss on the main increases a greater loss of pressure may be allowed on the local trunk mains. For simplicity in these calculations a mean size for these mains has been taken for all distances of transmission.

† Based on annual charge of 8 per cent for mains, 7½ per cent for low-pressure holders, and 6½ per cent for high-pressure holders.

during short periods in the summer when the whole load could be carried by the transmission main.

Local Distribution

Mains

The design of a local distribution system on a new estate or a new town depends so much on the lay-out of the streets that it is difficult to make any exact comparison between the size of mains required for supply at low pressure and intermediate pressure, respectively. The size of main depends on the length, allowable pressure loss, and the number of houses and maximum demand per house. The latter, of course, depends upon the number and types of appliances, but the maximum demand for any one house and for a group of houses is also greatly dependent upon the "diversity factor" in the use of appliances.

In order to obtain some comparative data the maximum length of main allowable has been worked out on the assumption that a pressure loss of 4 lb. per sq. in. (from 5 lb. per sq. in. to 1 lb. per sq. in.) may be allowed in any one street main in an intermediate system, and a pressure loss of 1 in. w.g. in a low-pressure system. The method of calculation is shown in Appendix 2. It is assumed that there are houses at regular intervals on both sides of the street, and the maximum length has been worked out for the following cases:

TABLE 5.—*Maximum Lengths of Street Mains*

Frontage of house in ft.(=f) ...	20	20	20	30	50	50	100
Maximum demand per house, cu. ft. per hr. (= q)	10	15	25	50	50	100	150
q/f	0·5	0·75	1·25	1·67	1·0	2·0	1·5

It should be noted that it makes no difference whether the houses have a frontage of 25 ft. and a maximum demand of 25 cu. ft. per hr., or a frontage of 100 ft. and a maximum demand of 100 cu. ft. per hr., the maximum length depends only on the ratio q/f.

The maximum lengths of main for sizes 4 in., 6 in. and 8 in. at low pressure, and 1½ in., 2 in. and 3 in. at intermediate pressure, are shown graphically in Figure 1. This indicates that for the conditions stated above a 1½-in. main at intermediate pressure

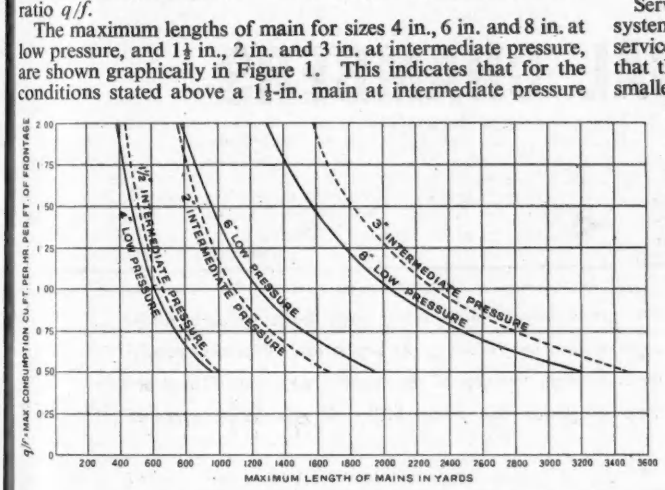

FIGURE 1.—*Maximum Length of Mains at Low and Intermediate Pressures.*

is equivalent to a 4-in. main at low pressure, and 2-in. and 3-in. intermediate-pressure mains are equivalent to 6-in. and 8-in. low-pressure mains. Figure 1 also shows that a 2-in. main may be used at intermediate pressure for a length of 750 yd., even at a value of $q/f=2$. The actual value of q/f for the town, taken as a whole, is less than 0·5, and the lay-out shown, providing 2-in. mains in all side streets, therefore allows of a considerable increase in demand.*

For the distribution systems for a town of 100,000 inhabitants 4-in. mains have been provided for the principal mains which supply the 2-in. street mains. Owing to the irregular intervals between branch mains it is not possible to apply a general formula to give the maximum length of 4-in. main allowable, but the pressure loss on these mains may be estimated approximately as follows: There are two or three 4-in. mains radiating from each storage station, and each main is less than one mile in length. Allowing for ten mains in all, it may be assumed that the maximum hourly load of 275,000 cu. ft. is equally divided between these mains, giving a maximum demand of 27,500 cu.ft. per main. It may be calculated that if this volume of gas were to pass through the whole length of one mile of 4-in. main the initial pressure, allowing for a 5 lb. per sq. in. terminal pressure, would be 11·4 lb. per sq. in. As the gas is distributed *en route* to the branch mains the pressure of 10 lb. per sq. in. given by the governor at the storage station is ample.

For similar conditions a 3-in. main would require an initial pressure of 25 lb. per sq. in., and even allowing for the lower loss due to distribution *en route*, and the fact that the average length is less than one mile, this would be hardly adequate.

In an intermediate-pressure system, valves are required on each branch main and at intervals along the principal supply mains, to allow of shutting-off the supply for alterations to the main or service connexions. The cost of these is included in the estimated costs of mains shown in Table 6.

Services

The size of service pipe is limited rather by strength than by carrying capacity, and it would probably be inadvisable to reduce the size below 1 in. even for intermediate-pressure supply. But a 1-in. service pipe, 100 ft. in length, which would have a capacity of 100 ft. per hr. at a pressure loss of 0·2 in. w.g., could be used for 1,000 cu. ft. per hr. or more at intermediate pressure; there would, therefore, be no need to lay services larger than 1 in. even for "all-gas" houses or gas of low calorific value, and 1-in services would also be sufficient for many industrial supplies.

In an intermediate-pressure system a service cock or valve should be provided on each service close to its connexion to the main, so that the service may be shut off for alterations to the governor or meter connexions, etc.

Service Governors

Service governors are essential on an intermediate pressure system, but the cost should be no greater than for low-pressure service governors, say, 30s. each. It would probably be found that the governor for use at an intermediate pressure would be smaller and more robust than the low-pressure service governor, because a much higher pressure loss across the valve would be permissible, while the limitation of inlet pressure to a maximum of 10 lb. per sq. in. would make it unnecessary to provide for so powerful a "shut-off" as is required on a high-pressure governor.

A good case could be made for fitting governors to all low-pressure supplies as part of that better service to consumers which it is hoped to provide in the future. While the reasons are well known it may be useful to state them again

(*a*) It is impossible to avoid variations in pressure if the capacity of the mains is to be used economically, and even a relatively small variation of pressure is detrimental to the operation of appliances.

(*b*) Where regular systems of maintenance are in operation, the adjustment of appliances is usually made in the summer months, and at times of day when the demand is light. The adjustment is therefore frequently made to a pressure above that available when the appliances are most often required.

These difficulties can only be surmounted by the use of governors either on the service or appliances, and a service governor has the advantage of providing a uniform pressure for metering the gas. Although in badly carcassed houses the pressure losses in the internal piping may partially nullify the effect of the service governor, this difficulty should not arise in the case of new houses where an adequate carcass can be installed when the house is built.

It is considered, therefore, that at least part of the cost of governors on an intermediate-pressure system should be considered as the cost of improved service to the consumer, rather than an expense due to the system of distribution.

The cost of maintenance of service governors is estimated at 3s. per year, based on 2s. per year for an annual inspection, and 12s. once in ten years for exchanging the governors for overhaul. The annual charge is calculated at 15 per cent, being 10 per cent for maintenance and 5 per cent for interest and depreciation.

(*To be continued*)

* Although a single 2-in. main would be large enough to supply both sides of the street, duplicate mains have been allowed for in the wider streets in order to avoid very long services.

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INDUSTRIAL GAS CONVERSIONS*

By EDMUND BATES, Manchester Gas Department

IMMEDIATELY before the war the main problem that faced the managements of gas undertakings was not that of making gas, but of its disposal. Fortunately, the Industry has tackled this matter thoroughly and by working in close co-operation with gas appliance manufacturers great strides have been made over the last decade in the design of gas burning equipment. Appreciating that the domestic field had limited possibilities, industry was surveyed and found to hold a great future for the development of gas sales. Because of this many undertakings turned their attention to the industrial applications of gas and consequently reaped the benefit of increased consumption, often being able to use manufacturing plant that would otherwise have been standing idle. This kept overhead charges down and made cheap gas for special purposes a possibility, thus leading to still further sales.

An industrial concern desiring to use gas can either install a new appliance, or, if using apparatus fired by other means, convert, if practicable, to gas firing. As a rule, a higher efficiency is obtainable by installing a specially designed appliance, but as most firms are unwilling to scrap anything that is in good condition, sometimes a conversion is the only method of introducing gas to the factory. On no account, however, should a conversion be carried out unless there is a good chance of success, otherwise a lot of harm can be done regarding the further application of gas for other purposes. A good method, and one that gains confidence, is to offer to convert the appliance and run it over a pre-determined trial period. Should the change-over be a success, it is understood that the consumer pays for the alteration, but if a failure, the appliance would be restored to its former condition at no cost. By applying suitable technical knowledge and experience, this latter state is very unlikely to arise, and consequently another satisfied consumer is gained.

In wartime a particular advantage of a converted appliance is that with little alteration it is possible to run on alternative fuels, thereby ensuring continuity of output under exceptional conditions.

Modern industry employs a variety of fuels for an infinite number of processes and gas is capable of providing heat in most cases, the main factors being the correct method of application and price. Research and experience are rapidly solving the first problem, and after the war no doubt they will also be employed to reduce the price, which is invariably the deciding point.

Here are a few brief examples of conversions:

Coal

Clog Iron Annealing Furnace.

This furnace originally consisted of a furnace chamber 4 ft. 6 in. by 2 ft. 6 in. by 18 in., with a fire box at the back. The flues and products of combustion passed through ports in the back end wall of the chamber, along the chamber arch, over the clog irons, eventually leaving through ports in the front of the hearth which connected to flues running the full length under the hearth. These flues terminated in a main flue and connected to a stack, the draught being controlled by a counterbalanced plate damper.

The method of conversion was quite simple. Four British Furnace tunnel type burners were built into the back wall of the heating chamber, the original flame ports being bricked up. The four burners were supplied by a common air-gas pipe which fitted conveniently into the previous fire box. The air-gas mixture was provided by an inspirator supplied with gas at 3½ in. and air at 1 lb. from an electrically driven single stage silent fan. The whole of the furnace brickwork was pointed with fireclay and the top insulated with bricks on edge giving a 4½ in. covering. The damper was set to give a slight pressure in the combustion chamber and the air-gas mixture so adjusted that scaling of the clog irons did not occur. This meant a slightly reducing atmosphere. It is important that the minimum excess gas is employed, or otherwise substantial heat loss due to unburnt gas passing up the stack will result.

This installation proved very satisfactory in a number of ways. First, when operating on coal it was necessary to light up the furnace some 24 hours before work could be started. This meant waste of fuel and labour and at the same time a large quantity of smoke escaped into the shop, causing unhealthy conditions for the workmen. On gas, the heating up time was reduced to 1½ hours and regarding running costs, it is sufficient to say that, although the firm concerned owned their own colliery, this method of heating is much preferred. The products, too, were more uniform, free from scale, and perfectly clean to handle.

The whole arrangement was so satisfactory that a reheating furnace and tack blueing furnace were subsequently converted, although in each case the furnace was some 40 years old. These conversions made the firm gas-minded and subsequently one of the furnaces was rebuilt, utilizing the existing conversion gas burner equipment. This, of course, increased the efficiency considerably.

Oil

Bolt Heading Furnace.

This process requires one end of round section steel bars from 3 in. to 6 in. long to be heated to 1150°C. prior to forging the bolt head in dies on a special machine. This furnace originally consisted of a combustion chamber 18 in. wide by 12 in. long by 10 in. deep, heated to 1350°C., the two firebrick side walls, bottom and top, being 4½ in. thick. The ends comprised two firebrick blocks, each provided with 16$\frac{7}{8}$ in. diameter holes, making a total for both ends of the furnace of 64 holes capable of heating bolts up to ¾ in diameter. The whole of the brickwork is built in an angle iron framework and supported on a stand at a convenient working height. Heat was originally provided by an oil burner firing into the combustion chamber through a hole in the roof tile. This burner was removed and replaced by a British Furnaces air blast burner and inspirator, a fan and motor being installed to provide the required air blast (1 lb. per sq.in.) for combustion and also for a screen of air at each end of the furnace. This air screen is essential if comfortable working conditions are to be attained.

Insulation was included in the conversion scheme and 2 in. brick encased in a sheet metal case was provided on the sides and top with consequent improved performance.

This furnace was erected alongside an existing oil-fired installation and a test was carried out as follows :

The oil furnace was operated in a normal manner, the oil being measured, and the bolts heated and stamped over the period of an hour. The gas furnace was adjusted to give exactly the same throughout, and it was found that 5 gallons of oil were equivalent to 1,100 cu.ft. of gas at 450 B.Th.U. In other words, approximately 5 therms of gas were equivalent to 8 therms of oil, showing a saving of 37% in heat input. From these figures it will be possible for calculations to be made with varying gas and oil rates to suit local conditions obtaining on other districts.

This furnace proved a success and two similar conversions of nut heating furnaces have been successfully carried out.

Among other conversions from oil to gas are bread baking ovens and a high pressure steam boiler.

Electricity

Print Glazing Machine.

The machine, in its original form, consisted essentially of an electrically driven stainless steel drum heated internally by electrical elements. A canvas belt conveyor runs under and comes into contact with the lower portion of the drum, and as wet photo prints are fed on to the conveyor, they are automatically picked up by the drum and travel round on the periphery. When the speed and temperature are correctly synchronized, the prints automatically drop off into a tray on travelling three-quarters of a revolution, this process imparting a glaze to the face.

The drum is supported at each end on spokes which radiate from a hollow shaft. Electric wires passed through the shaft and fed the heating elements with the necessary current.

The electrical equipment was removed and a ½ in. gas pipe fed through one end of the shaft, the other end being used to introduce a thermostat into the heated drum. By means of a suitable arrangement of piping, 12 industrial jets in two rows were applied and produced heat at a point some 3 in. away from the drum and a third of the way up. Baffle plates were fitted over the spokes at each end, leaving a space of 2 in. at the circumference, thus allowing ample ventilation and at the same time making lighting up easy by means of a gas torch.

This conversion has proved very successful and here again a further machine has since been adapted to gas firing.

Steam

Beer Bottle Washer.

This washer consisted of a half cylindrical vessel, in which a rotating frame dipped beer bottles into a steam-heated water bath, the steam being blown into the water through a ½ in. iron pipe. In this way the labels on dirty bottles were readily removed and the bottles partially cleansed prior to proceeding to the final brushing and spraying processes.

After many years' service the boiler failed, and as bottles cannot be handled or cleansed comfortably in cold water the question of some means of heating was considered. The cost of purchasing and installing a gas-fired steam boiler would have been in the region of £175, and this was considered rather high by the consumer. Furthermore, a solid fuel fired boiler was not desirable on account of dirt and storage space for fuel which was limited.

Two independently controlled bar burners, fitted with Selas atmospheric injectors were therefore fitted under the tank and an asbestos lined casing was installed. A large and a small burner were fitted, these being used singly or together according to the immediate heat requirements. The products of combustion were collected in a flue box and discharged through a flue into the room, which was very well ventilated, at a height of 12 ft. above the ground. To facilitate lighting up, a lighting torch was provided.

This installation, which cost only £27, has proved a success in every way and regular cleaning once a year is all that is required to maintain a very satisfactory performance.

* From a Paper to the Manchester and District Junior Gas Association, June 5.

Gas Products Prices

The London Market July 19.

All Coal Tar Products are in good demand, and Pitch in the London area remains about 45s.

The Control of Coal Tar Naphtha and Xylole Order, 1943 (S. R. & O. 1943, No. 768), differs from the 1942 Order mainly in the fact that it embraces the supply of these commodities in very small quantities.

The Provinces July 19.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 90's, 1s. 10d., pure, 2s. 5d. (controlled by the Control of Toluene No. 2 Order, July 3, 1941, which fixes the maximum price at which this material may be sold). Naphtha and Xylole controlled by the Coal Tar Naphtha and Xylole Order, 1943, dated May 31 (S. R. & O., 1943, No. 768), operative from June 1. Carbolic acid, 60's, naphthalene, and anthracene controlled by the Coal Tar Products Prices Order S. R. & O. 2509, dated Dec. 7, 1942, and operative from Jan. 1, 1943. Filtered heavy oil (min. gr. 1,080), 7¾d. to 8d. Creosote oil has been generally controlled as to direction and price for some time past. Current value—fuel grades 5d. to 5¼d.; timber preservation and other purposes 4¾d. to 6d.

* In regard to pitch and crude tar prices we would ask readers to refer to the editorial note on p. 396 of the "JOURNAL" for Sept. 10, 1941.

Tar Products in Scotland July 17.

Throughput is well maintained. Refined tar controlled. Value is 4½d. per gallon ex Works, naked. Creosote oil: Specification oil, 6½d. to 7d.; low gravity, 7½d. to 7¾d.; neutral oil, 6d. to 6½d.; hydrogenation oil, 5⅞d. per gallon; all *ex* Works in bulk. Refined cresylic acid is in greater supply at 3s. 6d. to 4s. 6d. per gallon *ex* Works, naked, according to quality. Crude naphtha 6½d. to 7d. per gallon. Solvent naphtha: Basic prices delivered in bulk, 90/180 grade 2s. 8d., and 90/190 Heavy naphtha, Unrectified, 1s. 10½d.; Rectified, 2s. 3d. per gallon. Pyridine: 90/160 grade, 13s., and 90/140 grade, 15s. per gallon.

Gas Stocks and Shares

The past week opened quietly, but as the good war news from Sicily developed markets became firmer and many industrials with post-war prospects made sharp improvements.

There was a little more business in the Gas Market, and although prices on the whole continued very firm there were very few movements. After a long period of gradual improvement, Imperial Continental closed 3 points down. On the other hand, Commercial ordinary made a further small advance, business being recorded up to 70.

In the list of debenture stocks on offer several small parcels giving comparatively high yields are available. Among these are the following: £370 Brighton 5% at 127 yielding £3 18s. %, £155 Commercial 5% at 112 yielding £4 9s. %, £200 East Hull 5½% at 125 yielding £4 7s. 6d. %, £360 East Surrey 5% at 127 yielding £3 18s. %, and £100 Romford 5% at 127, also yielding £3 18s. %.

The following price changes were recorded during the week:

OFFICIAL LIST

Commercial	66—71	+1	
Gas Light 4 p.c. Pref.	91—94	+1	
Ditto 3¾ p.c. Red. Pref. (*x.d.*)	93—96	July 15	
Imperial Continental	88—91	−3	
South Metropolitan 5 p.c. Red. Deb. (*x.d.*)	103—108	July 15	
United Kingdom Gas Corporation Ord.	20/—21/−	+−/3d	
Watford & St. Albans Ord.	110—115	+1	

PROVINCIAL EXCHANGES

Sheffield 4 p.c. Deb. (*x.d.*)	98—100	July 5
Weston-Super-Mare 4 p.c. Deb. (*x.d.*)	99—101	"
Ditto 7½ p.c. Deb. (*x.d.*)	142—147	"

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